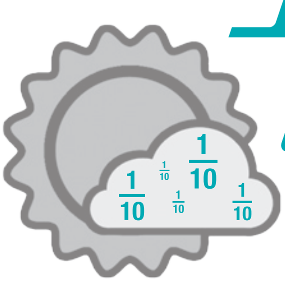

Sunny with a chance of tenths!

Using the familiar context of temperature to support teaching decimals

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As teachers we are encouraged to contextualize the mathematics that we teach. In this article, Belinda Beaman explains how she used the weather as a context for developing decimal understanding. We particularly enjoyed reading how the students were involved in estimating.

Introduction

A collective sigh filled the room when I announced that we would be investigating decimals. Mumbles about "the numbers with the full stops" accompanied the folded arms, and before I knew it, 27 grade 5 students were disengaged before we had even begun. Have you been there?

Decimals are grouped with ratio, percentages and fractions under the 'rational number' umbrella, and this group of topics is not generally favoured by teachers or students alike. Faced with this dilemma, I found a way to teach decimals to tenths that sneaks up on students before they even realise they are learning—and all teachers like that.

Why the weather?

The term 'context' might be described as the "non-mathematical meanings present in the problem" (Huang, 2004, p. 278). A connection, therefore, can form between mathematical content and application, based on the familiarity of the context to the problem solver (Huang, 2004).

The teaching of decimals needs to be anchored to where the student is 'comfortable' and requires the provision of a context for teaching with which a student can relate (Chinn, 2008). Showing students that decimals are part of their lives will ground the development of decimal sense in "meaningful experience" (Caswell, 2006, p. 28). In order to support students in their out-of-school learning

of mathematics, familiar contexts need to be recreated within the classroom so that students can begin to connect their classroom tasks to everyday experiences.

In summary, I needed to find a context that would engage students and show them how decimals are used in real life. I wondered how using the weather might work. This article describes sessions that were undertaken in my grade 5 classroom. Students observed hourly changes in temperature each school day for five days and plotted their findings on a graph.

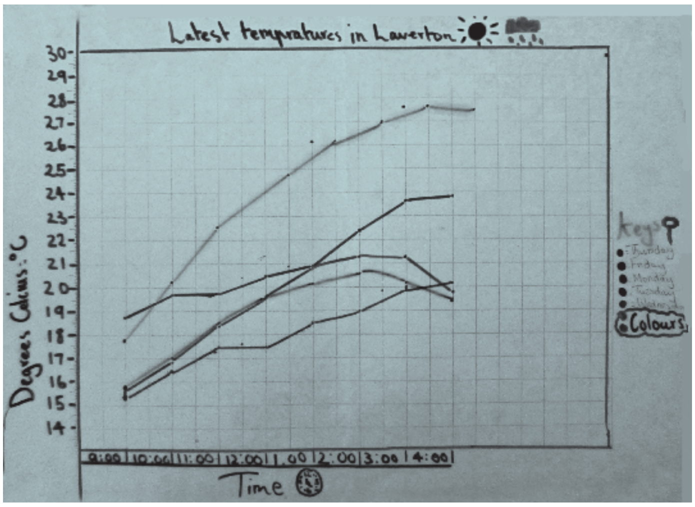

Figure 1. Student graph.

Organising the graph

Each student received a sheet of grid paper and set up their graph according to the teacher's displayed large copy. The hours of the school day ran across the horizontal axis, and temperatures in degrees lined the vertical. We started our graph at 14 degrees. It was November and temperatures were unlikely to creep below this, even at 9.00 am. This decision was based on quite a discussion to ensure students understood that if we did our graph in winter then we would need to include much lower temperatures. By this stage, students were unaware that this activity had anything to do with decimals; I had not even mentioned them yet.

Decimals sessions heat up

With graphs prepared and interest captured, we began to plot the temperature. I had consulted the Bureau of Meteorology website, which is refreshed several times each hour, and obtained the temperature for 9.00 am, 10.00 am and 11.00 am, as our mathematics sessions most days took place after this time. I asked my students to guess what the temperature was at 9 o'clock. I played the 'higher/lower' game, and almost all 27 hands were in the air, eager to 'get it'! However, many hands went down, and excitement was replaced with confusion when it became clear that the temperature was above 15 degrees but below 16 degrees. How could that be? I allowed the quiet chatter that followed, as students speculated if I had made a mistake.

It took only seconds before one student waved his hand in the air with gusto. "It must have tenths!" he yelled. All eyes were on him, and a few hesitant hands punctuated the air. Within seconds, hands were flying, guesses were forthcoming, and I was ready to launch into teaching tenths. Prior to this, we had looked at decimals using Linear Arithmetic Blocks (LAB; see Victorian Government Department of Education and Early Childhood Development, 2010). However, no contextual link had been made prior to this.

The weather lady

We would start every mathematics session the same way, plotting temperatures for that day and catching up on temperatures from the previous afternoon. Students would open up their graphs and chat about their estimations with the person next to them, and I would be the weather lady, ready with my hourly temperatures.

I would begin taking estimations. Each guess had to be accompanied by a brief justification, to which I would share some praise, then inevitably announce, "Higher!" or "Lower!" which would always be met with an edge-of-the-seat reaction of excitement or disappointment. Perhaps their estimation was out! However, while other hands were in the air, there was still time to think of another one.

Students actively developed their understanding of tenths, as can be evidenced by the scale shown in Figure 2. Here, the student has marked in her own tenths

without teacher prompting. It is even more interesting to note that she made the fifth tenth more prominent each time. I had continued to reinforce the idea that the fifth tenth was halfway between one temperature and the next, and it would appear that this student had consolidated this concept here, for herself. The graph sheets had been deliberately created so that the scale was not connected to centimetres. Even if this student made a connection with the visual of a ruler, she had brought her own prior knowledge to this task, as I had not made this explicit link for the students.

Figure 2. Tenths.

As the days went on, our estimations became more informed. We kept charts alongside our graph on the wall, which listed each day, each hour, and each temperature. These charts also had a space to record the change in temperature from one hour to the next, which was used during the week to develop mental addition and subtraction of decimal numbers. Students were able to base an estimation on the temperature at the same time on previous days, or based on the change in temperature experienced at this time on other days. I gave students time to develop a justification for their estimation and talk about it with the person beside them. That also freed me up to approach individuals needing support, or who simply wanted to talk to me about their thinking.

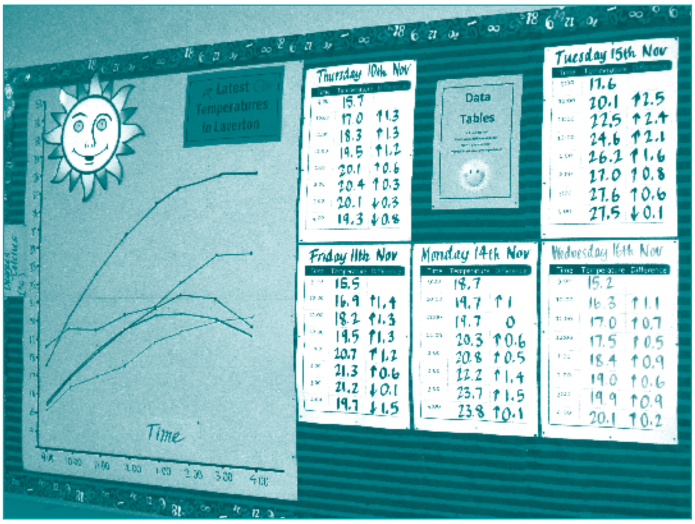

Figure 3. Wall display of graph and charts.

Sixteen point ten

The development of addition and subtraction began with recording the increase or decrease of the temperature. When the temperature was finally obtained, we would count, by tenths, from the temperature of the previous hour. This way we could find the difference, or the change, in temperature. If we counted 18 tenths, we knew that this was one whole degree plus 8 tenths, which could be written as 1.8. Counting each time was necessary, particularly when the skill of bridging was required. The volume of students' responses would get conspicuously softer as students approached, for example, "…16.8, 16.9, 17…". I am sure some hoped there was a number we could call 'sixteen point ten', but the practice of continually counting allowed these students to consolidate the bridging concept.

Some students did not need to count up by tenths when they discovered the addition and subtraction that could be carried out. The strategy of reaching the next whole was the most frequent. For example, a student might say, "To get from 15.8 to 16.2, I know it's four tenths because 15.8 plus two more tenths is 16, then another two tenths makes 16.2." This was impressive, considering it had not been not modelled for students immediately. Some students, who were looking for a quicker way of calculating the difference, followed these examples and copied quite keenly. After all, it was a strategy that worked which the teacher had not even shared yet! This sharing among peers was most effective.

Bring a jacket!

My favourite conversations to overhear were the ones regarding memory of the actual weather. "No," a student might say, "I'm sure that this morning it was colder than yesterday morning because I wasn't wearing a jumper yesterday." Students were not even thinking, here, in terms of numbers first. They truly were relying on real-world experience to guide their own estimation of the temperature. Some would even say, "It was colder by more than a tenth because that would hardly even be any different." Even students who usually required support in mathematics were grasping the size of tenths by relating them to whole degrees, and then, to their own experience of the weather. They would even quite keenly add this reasoning to their justifications. And why not? Students were blurring the line between mathematics and real life experience smoothly and with conviction.

Cool feedback

Contextual examples of decimals in operation have their limitations (see Steinle, 2004; Irwin, 2001), and this present example is not excluded. It deals exclusively with wholes and tenths, and the use of the word 'degrees,' which is also the unit of measurement for angles, could prompt some criticism. My students were not disadvantaged by these limitations. I did teach decimals beyond tenths using the LAB. Thanks to our temperature observations, students had a lively and developing understanding of tenths, including simple operations, that they were able to apply to their new discoveries about hundredths and thousandths. Regarding the use of 'degrees', I pointed out very early to my students that angles are measured in degrees too, but a different kind of degree. We had investigated angles two terms earlier, and students were satisfied with a brief discussion to clarify this sharing of terms. It did not prove to be an issue, and was not raised by any student throughout the sessions.

The forecast

Students in my grade 5 classroom completed pre- and post-testing of their decimals learning and the final results were impressive, but, from the learning I had witnessed, this testing was only proof of what I knew. Using the temperature, which is a strong and importantly, familiar, contextual examples of decimals in operation proved to be a most effective way to provide students with opportunities to practise and refine their understanding of tenths, especially when combined with LAB as concrete representation. This combination of ideas worked in my room, where dialogue was unprompted, unscripted and never boring, rather like Melbourne's weather. In fact, it appeared as if Melbourne's weather had, for a change, been quite reliable indeed.

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